

CLAIMS

What is claimed is:

1. An over expanded, limited temperature cycle for operating an engine comprising:
a compression process 1-2-3, said compression process 1-2-3 further comprising:
a first compression process 1-2 carried out via an external compressor; and
a second compression process 2-3 carried out by changing the volume of a cylinder of said engine;
a heat addition process 3-4-5, said heat addition process 3-4-5 further comprising:
a first heat addition process 3-4 carried out via injection and combustion of fuel in said cylinder of said engine while maintaining a constant pressure; and
a second heat addition process 4-5 carried out via injection and combustion of fuel in said cylinder while maintaining a constant, limiting temperature;
an adiabatic expansion process 5-6;
a heat removal process 6-7-1, said heat removal process 6-7-1 further comprising:
a first heat removal process 6-7 under a constant volume; and
a second heat removal process 7-1 under constant pressure;
wherein said compression process, said heat addition process, said adiabatic expansion process, and said heat removal process combine to form an over expanded, limited-temperature cycle 1-2-3-4-5-6-7-1.

2. The over expanded, limited temperature cycle of claim 1, wherein the change of volume associated with the compression process 1-2-3 is less than the change of volume associated with the heat addition and adiabatic expansion processes 3-4-5-6.

3. A method for combusting fuel in an engine comprising:
decreasing a first volume of a gas to a second volume;
further decreasing the second volume to a third volume while increasing a pressure and a temperature thereof;
increasing the third volume to a fourth volume at constant pressure while adding a first amount of heat via injection and combustion of fuel in a cylinder of said engine until a predetermined temperature is attained;
increasing the fourth volume to a fifth volume while adding a second amount of heat via injection and combustion of fuel in said cylinder while decreasing the pressure thereof and while maintaining the temperature constant at the predetermined temperature;
increasing the fifth volume to a sixth volume while decreasing the pressure and temperature thereof;
decreasing the pressure to atmospheric pressure while removing heat at a constant volume; and
decreasing the sixth volume to the first volume while removing heat under constant pressure.

4. The method of claim 3, wherein a firing pressure is substantially equal to or less than a compression pressure.

5. The method of claim 3, wherein said first amount of heat corresponds to $Q = T_3 \times [(V/V_3) - 1] \times C_p$; wherein
 Q is said first amount of heat;

4 C_p is the specific heat of said gas at constant pressure;
5 V_3 is said third volume.

1 6. The method of claim 3, wherein said second amount of heat corresponds to $Q = T^* \times [1 -$
2 $(V_4/V)^{k-1}] \times C_v$; wherein
3 Q is said second amount of heat;
4 C_v is the specific heat of said gas at constant volume;
5 T^* is said predetermined temperature;
6 V_4 is said fourth volume; and
7 k is C_p/C_v , where C_p is the specific heat of said gas at constant pressure.

1 7. The method of claim 3, wherein the step of increasing the fifth volume to a sixth volume
2 is an adiabatic expansion.

1 8. An engine comprising:
2 an over expanded, limited-temperature cycle engine adapted to combust fuel by:
3 decreasing a first volume of a gas to a second volume;
4 decreasing the second volume of a gas to a third volume while increasing a pressure and a
5 temperature thereof;
6 increasing the third volume to a fourth volume at constant pressure while adding a first
7 amount of heat via injection and combustion of fuel in a cylinder of said engine until a
8 predetermined temperature is attained;

9 increasing the fourth volume to a fifth volume while adding a second amount of heat via
10 injection and combustion of fuel in said cylinder while maintaining the temperature constant at
11 the predetermined temperature;
12 increasing the fifth volume to a sixth volume while decreasing the pressure and
13 temperature thereof;
14 decreasing the pressure to atmospheric pressure while removing heat at a constant
15 volume; and
16 decreasing the sixth volume to the first volume while removing heat under constant
17 pressure.

1 9. The engine of claim 8, wherein a firing pressure is substantially equal to or less than a
2 compression pressure.

1 10. The method of claim 8, wherein the step of increasing the fifth volume to a sixth volume
2 is an adiabatic expansion.

1 11. The engine of claim 8, further comprising a scavenging air compressor providing
2 compressed air to said engine.

1 12. The engine of claim 8, wherein said engine is a two-stroke engine.

1 13. The engine of claim 12, further comprising a scavenging air compressor, said engine
2 having a two stroke construction comprising:
3 a first stroke enabling a combustion process at its beginning with an expansion process
4 throughout its entire stroke; and
5 a second stroke having more than one half of said stroke allocated for exhaust and
6 scavenging processes, with the remaining portion of said stroke allocated for further compression
7 of scavenging air provided by said scavenging air compressor.

1 14. The engine of claim 13, wherein said engine achieves an expansion process having a
2 longer stroke than the stroke for said compression process.